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Kentucky Plant Disease Management Guide for Soybeans

D.E. Hershman, Extension Plant Pathologist

This guide contains information on the biology and management of the most important diseases of soybeans in Kentucky. Fundamental information on symptoms, disease cycle, and management is provided. For some diseases, more extensive information on biology and management is also available in other Extension publications. Additional sources of information are listed under individual diseases.

Disease management in soybeans relies heavily on using disease-resistant varieties, when available, and employing sound agronomic practices. It is important to integrate both of these strategies into a comprehensive disease management program. Failure to consider one or the other will compromise the success of your efforts. The appropriate use of pesticides sometimes plays a significant role in managing certain diseases, but it is secondary to sound cultural practices and proper variety selection.

Resistance to one or more diseases is often incorporated into modern crop varieties. Unfortunately, resistance is not available for some diseases. However, when available, disease resistance is often the foundation for economical disease control.

No one variety is resistant to all diseases present in Kentucky. Also, the importance and prevalence of crop diseases vary from one farm to the next, and from one year to the next. These facts can complicate the variety selection process. Nevertheless, an informed decision can be made by selecting varieties with resistance to the diseases most likely to be a problem. Resistance to other diseases should be considered on a secondary basis.

While it is not possible to know with complete certainty which diseases will develop, the disease history of the farm and area will indicate which diseases are most likely to occur. A disease history for a farm is established by scouting fields and identifying disease outbreaks when they occur. Your county Extension agent, farm supply dealer, and neighbor can also be good sources of information. However, farm-specific information obtained through field scouting is the most reliable basis for developing a farm disease history.

When selecting a variety, recognize that there are different levels of disease resistance. If available, agronomically acceptable varieties with high levels of resistance usually provide the best protection against a serious disease outbreak. Under reduced disease pressure, however, a moderate level of resistance may be enough to achieve acceptable results. For some diseases, low to moderate resistance is all that is available among current commercial varieties, even though higher levels of resistance would be desirable. In these cases, use of a variety with even a low level of resistance is usually superior to planting a susceptible variety. However, recognize that using low to moderate levels of resistance may require you to pay greater attention to other disease management strategies in order to achieve good results. Varieties can also be selected for tolerance — the ability to yield well even though symptoms develop. Information on disease-tolerant varieties is limited, but tolerant varieties can be useful when available.

Always use pesticides safely and according to the label. Misuse of pesticides can be hazardous to the farmer, farm workers, the growing crop, the consumers of the harvested commodity, and/or the environment. The label is the most reliable source of up-to-date information on a pesticide. ALWAYS READ THE LABEL BEFORE USING A PESTICIDE, AND FOLLOW LABEL INSTRUCTIONS.

Anthracnose

CAUSE: *Colletotrichum dematium* var. *truncatum* and several related species and fungal var. and *Glomerella* spp.

SYMPTOMS: Symptoms can develop in soybeans at any stage of crop development. Most commonly, however, symptoms appear in the later reproductive stages. Stems, leaf petioles, and pods are covered with small to large, irregular, brown blotches. Blotches are embedded with black fungal bodies which have small, but visible, spines. Foliage develops brown lesions on the veins and cankers on leaf petioles. Leaves may roll and

defoliate prematurely. Plants can be stunted. Infected pods may be shriveled and contain no seed (pod blanking); or more two-seeded pods, with shriveled moldy seed, may be evident. Pods can be diseased and seed infected, but symptoms on seed may not be evident. Anthracnose and pod and stem blight frequently occur together on the same plants late in the season.

KEY FEATURES OF DISEASE CYCLE: The fungi survive between seasons in infested crop residue and seed. Plants can become infected at any stage of development, but are especially susceptible during bloom and pod fill. Disease is favored during prolonged periods of wet weather and is evident to one degree or another every time soybeans are grown. Disease is most severe on soybean cultivars that mature during late summer; thus, it tends to be more of a factor on early maturing cultivars.

MANAGEMENT: Resistance to various phases of anthracnose exists in soybeans, but the reactions of the most commonly grown cultivars are poorly defined. For practical purposes, all soybean cultivars are susceptible to anthracnose. Sow high-quality, disease-free seed (e.g., certified seed). Treating seed with fungicides, such as thiram alone or in combination with other materials, will help to improve emergence of infected seed. Treating fields with foliar fungicides, such as benomyl, can improve yields and/or protect seed quality when anthracnose is a problem. Protecting seed quality of early- to mid-maturity cultivars with a fungicide application during mid-pod fill has shown consistent results when conditions favor anthracnose development. Protection of crop yield is less reliable because the need to apply fungicides for this purpose is less predictable in Kentucky. Rotating fields out of soybeans and plowing infested soybean residue will help in overall anthracnose management on the farm.

SOURCES OF ADDITIONAL INFORMATION:

1. Foliar Fungicides Can Improve Soybean Seed Quality, Ky. Seed Improvement Assoc. Pamphlet
2. SOYSPRAY, UK College of Ag Expert System

Bacterial Blight

CAUSE: *Pseudomonas glycines*

SYMPTOMS: Foliage exhibits random, small, angular, brown spots with a distinct yellow halo. Leaf spots may drop out of the leaf with age and give a shot-hole effect. Leaves may eventually become ragged and tattered. Severely diseased leaves may drop off plants. Symptoms usually appear 5-7 days after a storm. Pods can develop brown to black lesions that frequently expand to cover much of each pod's surface area. Infected seed can be symptomless, discolored, or shriveled. Bacterial blight is common in Kentucky, but the disease rarely causes economic losses.

KEY FEATURES OF DISEASE CYCLE: The bacterium overwinters on infested crop residue and in seed. Most bacterial spread and infection occurs during windy, cool, wet weather. Free-standing moisture is required for infection. Infection and disease progress are checked during warm (or hot) dry weather. Bacteria can be spread and disease increased following cultivation of fields when leaves are wet.

MANAGEMENT: Plant high-quality, disease-free seed (e.g., certified seed). Do not cultivate crops when wet. Rotate crops and plow infested residue for future management of bacterial blight on the farm.

Bean Pod Mottle

CAUSE: Bean Pod Mottle Virus (BPMV)

SYMPTOMS: Symptoms include faint mottling of developing leaves and slight cupping of leaf bases. Stems of infected plants will remain green after plant is mature. Petioles may not drop off plants during normal leaf drop. Dual infections with BPMV and soybean mosaic virus can result in severe plant stunting, distortion, and even death. While BPMV is known to be widespread in Kentucky, associated yield losses (reported to be as high as 50% in some situations) are usually minimal. This may be due to yield compensation by non-infected plants that neighbor infected plants. However, plants with BPMV are greatly predisposed to seed quality problems due to infection by *Phomopsis* spp. fungi.

KEY FEATURES OF DISEASE CYCLE: The virus overwinters in Kentucky, but the overwintering host has not been identified. BPMV can be transmitted in seed, but the bean leaf beetle is the most common means of transmission. BPMV may overwinter in dormant, adult bean leaf beetles.

MANAGEMENT: Early planting may provide a means for plants to escape serious infection. Control of bean leaf beetles during early crop development with insecticides may help limit transmission of the virus. However, this practice is rarely economical unless economic threshold levels are reached for bean leaf beetles.

Bean Yellow Mosaic

CAUSE: Bean Yellow Mosaic Virus (BYMV)

SYMPTOMS: Bean yellow mosaic is evident as patches of bright yellow mottling associated with leaf veins. The disease is rarely more than a curiosity in commercial fields.

KEY FEATURES OF DISEASE CYCLE: BYMV overwinters in various weeds and pasture crops in Kentucky. It is transmitted to soybeans by several species of aphids.

MANAGEMENT: Control measures are not warranted.

Brown Spot

CAUSE: *Septoria glycines*

SYMPTOMS: Pin-point to small, angular, red-brown spots form on unifoliate leaves 2-3 weeks after planting. Spots are more pronounced on lower leaf surfaces. Numerous spots cause leaves to yellow and drop off plants. Trifoliate leaves develop numerous, irregular, tan lesions that later turn dark brown. Leaf yellowing is usually prominent. Individual spots frequently coalesce to form large blackish-brown blotches. Defoliation of severely diseased trifoliate leaves is common during wet seasons. Defoliation typically occurs from the bottom of the plant to the top. Early season brown spot will appear annually in almost every field in Kentucky. Late-season brown spot is much more variable in occurrence and severity.

KEY FEATURES OF DISEASE CYCLE: The brown spot fungus overwinters in infested crop residue. Infections take place when fungal spores are splashed onto foliage. Infections early in the season are frequently the source of late-season infections. Disease is most severe during periods of cool, wet weather.

MANAGEMENT: All soybean cultivars are susceptible to brown spot. Rotate soybeans with other crops and plow under infested residue, where practical. Foliar fungicides can be used to control brown spot, but economic returns associated with the practice are highly variable in Kentucky.

SOURCES OF ADDITIONAL INFORMATION:

1. Brown Spot of Soybean, PPFS-45

Cercospora leaf blight (Purple Seed Stain)

CAUSE: *Cercospora kikuchii*

SYMPTOMS: Infected seedlings are stunted and may die as a result of stem girdling. Infected seed leaves may shrivel, turn purple, and drop prematurely. Late in the season, upper leaves of plants develop extensive blighting over large portions of fields. Blighting is the result of numerous pin-point spots to irregular blotches that are red-purple in color. Affected foliage defoliates prematurely. Small reddish-purple, slightly sunken lesions form on stems and leaf petioles. Infected seed exhibit varying degrees of pink to purple seed coat discoloration. Only the leaf blight phase of this disease affects yield. Seed discoloration is a cosmetic seed quality problem, primarily affecting marketability.

KEY FEATURES OF DISEASE CYCLE: The fungus survives between seasons in seed and infested crop residue. Infected seed give rise to diseased seedlings. Infectious spores are produced by infected seedlings, infested crop residue, and certain weeds. Spores are blown or splashed onto upper plant parts, and infection occurs during warm, wet weather.

MANAGEMENT: Plant high-quality, disease-free seed (e.g., certified seed). Resistant soybean cultivars are available, but the disease reactions of commonly grown cultivars are poorly defined. Plant late-maturing cultivars, or delay planting early- to mid-season cultivars. Treat seed with a broad-spectrum fungicide. Foliar fungicides can control both the foliar and seed phases of this disease, but the practice is rarely economical in Kentucky. Rotate soybeans with other crops.

SOURCES OF ADDITIONAL INFORMATION:

1. Foliar Fungicides Can Improve Soybean Seed Quality, Ky. Seed Improvement Assoc. Pamphlet
2. SOYSPRAY, UK College of Ag Expert System

Charcoal Rot

CAUSE: *Macrophomina phaseolina*

SYMPTOMS: Infected seed may rot prior to germination or give rise to diseased seedlings which soon die. Older diseased plants turn yellow and wilt, especially during hot, dry weather. Severely diseased plants die; dead leaves turn brown and remain attached. Ash-grey to black lesions may be evident at the bases of affected plants. Small black bodies, resembling ground pepper, will be evident under the outer tissue of the bases of plants and tap roots. Black streaks will be evident in the lower stem when it is split open.

KEY FEATURES OF DISEASE CYCLE: The charcoal rot fungus survives from season to season in soil and infested soybean, corn, and grain sorghum stubble. It can also be transmitted on seed. Plants are often infected early in the season, but the disease generally goes dormant until the onset of hot, dry weather in mid-to late season. Charcoal rot may not be evident in years where moisture is adequate throughout the growing season.

MANAGEMENT: Continuous soybean production maintains the fungus at high levels. Rotating soybeans with other crops will help reduce these levels and lower the potential for serious damage. The fungus can infect corn and grain sorghum, but these crops will not support the high fungal populations which develop when soybeans are produced. Consequently, rotating soybeans with corn or grain sorghum, while not as effective as growing non-host crops, is superior to continuous soybean production in managing charcoal rot. Fertilize fields according to soil test recommendations. Plant high-quality, disease-free seed (e.g., certified seed). Planting full-season soybeans may help plants escape damage. Avoid excessive seeding rates and plant crowding. Planting soybeans no-till into wheat stubble (doublecrop) may reduce disease by reducing water stress in the soybean crop. Where possible, irrigate soybeans to avoid drought stress. Avoid injury to crops and manage soybean cyst nematode if it is a problem. Tillage of infested corn and soybean stubble may help reduce populations of the fungus.

SOURCES OF ADDITIONAL INFORMATION:

1. Charcoal Rot of Soybean, PPFS-47

Downy Mildew

CAUSE: *Peronospora manshurica*

SYMPTOMS: Foliage develops yellow spots that enlarge slightly into irregular gray-brown spots with a yellowish margin. When viewed from the underside of leaves, spots have a slightly gray, fuzzy appearance. Leaves become resistant to infections with age. When pods become infected, the fungus is visible inside the pods as an encrusted fungal mass. Infected seed has a dull white appearance and is partially or completely encrusted by the causal fungus, but germination will be little affected. Downy mildew is rarely a serious problem in Kentucky; nonetheless, low levels of the disease, primarily foliar infections, are very common.

KEY FEATURES OF DISEASE CYCLE: The causal fungus overwinters in infested crop debris or seed. Spores are spread to and infect soybeans during periods of high humidity/moisture and relatively cool temperatures. Excessive soil moisture may encourage disease development.

MANAGEMENT: Plant high-quality, disease-free seed (e.g., certified seed). Rotate soybeans with other crops. Plow under infested residue where downy mildew has been a serious problem. Resistance to downy mildew is available, but the reactions of commonly grown soybean cultivars are poorly defined.

SOURCES OF ADDITIONAL INFORMATION:

1. Downy Mildew of Soybean, PPFS-48

Frogeye Leaf Spot

CAUSE: *Cercospora sojina*

SYMPTOMS: Small, circular to angular, reddish-brown spots develop on leaves in mid- to late season. As spots enlarge (up to 1/4 in) they develop off-white centers with a red-brown border. Older spots become papery thin and frequently become tattered. Numerous spots may coalesce and cause leaves to drop prematurely. Pods, seed, and stems can become infected, but frogeye is primarily a foliar disease.

KEY FEATURES OF DISEASE CYCLE: *C. sojina* survives the winter in seed and infested residue. Spores are carried by air currents and infect soybeans during warm, wet weather.

MANAGEMENT: Rotate soybeans with other crops. Plant high-quality, disease-free seed (e.g., certified seed). Treating seed with broad-spectrum fungicides will help to control seed transmission of the fungus. Plant resistant soybean cultivars where frogeye has been a serious problem. Resistance is best developed in late-maturing soybean cultivars. Avoid excessive seeding rates. Fungicide sprays at early- and mid-pod fill will control frogeye; however, the inconsistent and generally low levels of frogeye in Kentucky make the economics of this practice questionable.

Fusarium Blight

CAUSE: *Fusarium oxysporum*

SYMPTOMS: Tap roots and stems develop a brown discoloration. Innermost tissue of stems (pith) and tap roots may have a pinkish fuzzy appearance. Leaves wilt and plants die prematurely.

KEY FEATURES OF DISEASE CYCLE: *F. oxysporum* survives between seasons in soil and infested crop residue. The fungus is present in all agricultural soils. Infections can occur anytime during the season, but the disease is usually most evident from mid-season onward. Herbicide injury and infection of plants by the soybean cyst nematode predispose plants to fusarium blight. Disease is most severe following periods of cool, wet weather; these conditions favor infection and early disease development. Infected plants may succumb to infection during periods of water and/or heat stress.

MANAGEMENT: Plant high-quality, disease-free seed (e.g., certified seed). Use a broad-spectrum seed fungicide such as captan, maneb or thiram to reduce seedling infections. Plant when soil conditions favor rapid stand establishment. Avoid early no-till plantings where fusarium blight has been a problem. Stressed crops are more susceptible to fusarium blight than are healthy crops. Consequently, avoid crop damage due to herbicides or the soybean cyst nematode and maintain balanced soil fertility.

Phytophthora Root and Stem Rot

CAUSE: *Phytophthora megasperma* f.sp. *glycinea*, *P. megasperma* var. *sojae* and *P. sojae*

SYMPTOMS: Seed rots prior to germination or dies during or following emergence. Plants infected later may simply be stunted if disease-favorable conditions do not exist. Plants in this condition may be more susceptible to other diseases, leading to premature plant death. Severely diseased plants have rotted taproots and lateral roots. Stems exhibit a dark brown external discoloration from the soil line upward. Internal stem tissue is also discolored. Leaves of infected plants turn yellow, wilt, and die. Dead leaves usually remain attached to the stems of dead plants.

KEY FEATURES OF DISEASE CYCLE: The fungus can survive for long periods of time in infested soybean residue and in soil. Infection requires high levels of soil moisture. Infections are greatest, and disease severity highest, when flooding rains occur within one week of planting. Disease is most troublesome in heavy (clay) soils, where soil compaction is a problem, or where reduced tillage systems are used. Symptoms are frequently enhanced by warm, dry weather following infection.

MANAGEMENT: Improve surface drainage of fields. Tile or rip fields, where feasible, to enhance internal drainage. Avoid using minimum tillage practices where

Phytophthora has been a problem. Avoid planting soybeans in cool, wet soils. Prevent soil compaction by limiting farm equipment traffic in fields when soil is wet. Resistant varieties are available, but you must match the cultivar with the fungus race in the field. This information is generally not available for Kentucky. Tolerant varieties are effective against all races of the fungus, but are susceptible to root and stem rot for a period of 10-14 days after crop emergence. After this time, the tolerance becomes activated. To protect tolerant varieties early in the season use the fungicide metalaxyl as a seed treatment or as a soil application. Rotating crops with soybeans is generally not an effective means of control.

SOURCES OF ADDITIONAL INFORMATION:

1. *Phytophthora* Root and Stem Rot of Soybean, PPFS-49

Pod and Stem Blight

CAUSE: Various species of *Diaporthe* and *Phomopsis*

SYMPTOMS: Infected seed give rise to diseased seedlings that frequently become blighted and die. Stems and leaf petioles of older infected plants have tiny black specks (pycnidia) which are usually arranged in rows. Infected pods also have scattered pycnidia, and pods may be poorly developed. Infected seed are shriveled, cracked, and may be encrusted by a white fungal mass. Seed may be externally infected and show no symptoms. Pod and stem blight has little effect on crop yield, but seed quality can be greatly affected. Thus, the disease is principally of concern to soybean seed producers.

KEY FEATURES OF DISEASE CYCLE: The fungi survive the winter in both infected seed and crop residue. Infested crop residue can set the stage for high levels of pod and stem blight in fields. Seed infection occurs only if pods become infected. Pod infection occurs anytime from flowering onward, but extensive seed infection does not take place until plants have pods that are beginning to mature (R7 stage). Infection is favored during warm, wet weather. Also, damage of pods by insects favors both pod and seed infection. Early maturing soybean cultivars and early plantings tend to be more affected than later maturing cultivars and later plantings. This is because the former mature during more disease-favorable conditions than the latter. Delayed harvest significantly increases pod and stem blight levels in both early- and late-maturing cultivars.

MANAGEMENT: Rotate soybeans with other crops. Plant high-quality, disease-free seed (e.g., certified seed). Treat seed with seed protectant fungicides containing captan, carboxin and/or thiram. Avoid planting in cool, wet soils. Plant late-maturing cultivars, or delay planting of early- and mid-season cultivars. In seed production fields of early maturing and/or early planted cultivars, a single application of benomyl at the full-seed stage (R6) will protect seed quality. This treatment will not enhance

crop yields. Plow under infested crop residue to reduce pod and stem blight levels in subsequent soybean crops.

SOURCES OF ADDITIONAL INFORMATION:

1. Foliar Fungicides Can Improve Soybean Seed Quality, Ky. Seed Improvement Assoc. Pamphlet
2. SOYSPRAY, UK College of Ag Expert System

Seed and Seedling Diseases

CAUSE: Various Fungi

SYMPTOMS: Seed rot prior to germination. Seedlings rot and die before they emerge from the soil. Emerged seedlings have varying degrees of root rot, lower stem cankering and rot, seed leaf lesions, and stunting. Plants may die or survive infection, depending on the severity of disease and the growing conditions. Frequent skips in fields of 1 ft or more may lead to significant yield losses and/or weed competition.

KEY FEATURES OF DISEASE CYCLE: Depending on the fungus involved, they can survive in the seed, soil, and infested crop residue. Disease is usually promoted by adverse growing conditions and stress during seed germination and emergence. Cool, wet soil conditions are the most common predisposing factors. Herbicide injury or insect damage to young seedlings may also increase seedling diseases, especially those caused by *Rhizoctonia* and *Pythium*.

MANAGEMENT: Plant high-quality, disease-free seed (e.g., certified seed). Treat seed with a broad-spectrum fungicide. Avoid planting in cool, wet soils. Maintain balanced soil fertility. Avoid any herbicide injury to the developing crop. Tile or rip fields to enhance the internal drainage of soil. Improve surface drainage patterns, where problems exist. Avoid soil compaction problems by limiting equipment traffic when soils are wet. Rotation of soybeans with other crops may reduce the levels of some causal fungi. However, rotation will have little effect on fungi such as *Rhizoctonia*, *Pythium*, *Phytophthora*, and *Fusarium*. Seed and seedling diseases are generally encouraged by reduced tillage systems.

SOURCES OF ADDITIONAL INFORMATION:

1. Root and Lower Stem Diseases of Soybean, PPFS-50

Soybean Cyst Nematode

CAUSE: *Heterodera glycines*

SYMPTOMS: Yield damage, even when severe, is usually NOT associated with any visible symptoms.

When symptoms occur, they will be evident as plant stunting, reduced growth rate (i.e., canopy closure), plant wilting, general yellowing, yellowing of leaf margins, reduced nodulation on roots, and occasionally premature plant death. When symptoms occur, they are usually evident as groups of plants that follow oblong, circular, or streaked patterns. Cysts (bodies of female

nematodes about the size of a pinhead and white to golden-brown in color) are visible on diseased roots four weeks after planting and throughout the rest of the season. Cyst numbers are greatest on small roots, so plants must be dug, not pulled, when looking for cysts. A 10X hand lens is helpful when attempting to detect cysts on roots. Do not confuse cysts with nitrogen fixation nodules, which are much larger than cysts.

KEY FEATURES OF DISEASE CYCLE: Soybean cyst nematode (SCN) survives the winter as eggs in cysts. Eggs can remain viable in cysts for many years in the absence of soybeans. Eggs give rise to worm-like juveniles in the spring when soil temperatures are warm enough to allow soybean planting. Juveniles enter roots, go through several growth stages, and break through the root surface as a visible cyst. A large number of cysts on a root system inhibits water and nutrient uptake by plants. The resultant stress leads to yield loss. Yield loss due to SCN is related to the number of nematodes that are present at planting; the most significant damage to soybeans occurs early in the season. Other crop stresses will increase damage due to SCN. SCN completes two to three life cycles in the course of a growing season. Thus, SCN can reach high and damaging levels in a single year when susceptible soybeans are grown. While this is true, susceptible soybeans will sustain little or no yield damage if SCN populations are low at planting. SCN populations decrease significantly (60-80%) when exposed to non-host crops and appropriate resistant soybean cultivars.

MANAGEMENT: Sample **all** soybean fields for SCN in the fall, winter or early spring **prior** to planting. If an SCN analysis indicates a field has moderate to high nematode levels, plant a non-host crop, such as corn or grain sorghum, or a resistant soybean cultivar. Use a resistant cultivar that has resistance to multiple SCN races. Do not plant resistant cultivars more frequently than once every three years. Failure to do this could result in a shift of the SCN race which would limit the usefulness of resistance in SCN management programs. Periodically plant susceptible cultivars to reduce SCN race shifts; however, always sample fields prior to planting to make sure SCN is below damage thresholds. Generally, susceptible cultivars should not be grown more often than once every four years. More frequent usage may be possible where susceptible cultivars are doublecropped behind wheat using no-tillage methods. Always base soybean cropping decisions on the results of SCN analyses. Maintain balanced soil fertility and fertilize fields according to soil test recommendations. Use any production practice that enhances overall crop health. Nematicides can be used to control SCN, but the cost of chemicals is great compared with the cost of alternative control measures.

SOURCES OF ADDITIONAL INFORMATION:

1. Soybean Cyst Nematode in Kentucky, PPA-3
2. Annual Kentucky Soybean Performance Tests, Progress Report 348

Southern Stem Blight

CAUSE: *Sclerotium rolfsii*

SYMPTOMS: Brown girdling cankers develop just below and at the soil surface. A white fungal mat is frequently present on the lower stem and crown, especially during hot, humid weather. Spherical, tan to brown fungal structures that are the size of mustard seed will form within the fungal mat and/or cankers. Leaves wilt suddenly and plants die. Dead leaves remain attached to stems. Plants can be affected anytime during the season. Seedling infections may cause large skips in rows, due to the movement of the disease down rows. Later in the season, plants die in small groups or individually as scattered plants.

KEY FEATURES OF DISEASE CYCLE: *S. rolfsii* survives the winter in infested crop residue and, more commonly, in soil. The survival structure of the fungus is called a sclerotium. Sclerotia germinate and infect plants when soil temperatures are high and moisture moderate to dry. Cool temperatures inhibit disease development. Disease is encouraged in sandy soils, especially where surface organic matter is abundant.

MANAGEMENT: Rotate soybeans with other crops. Three to four years between soybean crops may be needed if *S. rolfsii* levels are high in a soil. Some soybean cultivars resist or tolerate infection by *S. rolfsii*, but the disease reactions of commonly grown cultivars are poorly defined. Seedling disease may be reduced when seed fungicides are used. Avoid cultivating soil once disease is detected. Plowing infested soybean stubble will help to reduce soil populations of the causal fungus.

SOURCES OF ADDITIONAL INFORMATION:

1. Southern Blight of Soybean, PPFS-51

Soybean Mosaic

CAUSE: Soybean Mosaic Virus

SYMPTOMS: Infected plants are stunted. Leaves will show a yellowish vein clearing, curled leaf margins, mosaic patterns, and leaf crinkling. Pods of infected plants may be abnormally small and somewhat flattened. Seed may be reduced in size and may show a brown to black mottling pattern. SMV is primarily a seed quality problem, especially relative to export markets.

KEY FEATURES OF DISEASE CYCLE: The virus is primarily transmitted by seed, but may also be transmitted by aphids to some extent. The virus has no overwintering hosts in Kentucky and can survive the winter only in infected seed.

MANAGEMENT: Plant high-quality, disease-free seed (e.g., certified seed). Some resistant varieties are available. Early planting may be of some benefit.

Stem Canker

CAUSE: *Diaporthe phaseolorum* var. *caulivora*

SYMPTOMS: Reddish-brown stem lesions develop during the early reproductive stages, usually in the vicinity of a stem node. Initially, green stem tissue will be evident both above and below the lesions. Lesions expand both up and down the stem and eventually develop into dark brown to black sunken cankers. Cankers which coalesce may be confused with stem discoloration caused by *Phytophthora*. However, stem canker usually forms higher on the plant than does *Phytophthora*. Severe stem cankering results in premature, and often sudden, plant death. Foliage of diseased plants initially exhibits interveinal yellowing. This is followed by tissue death between the veins. Eventually, leaves die and usually remain attached to stems. Stem canker can result in the death of scattered plants or an entire field in severe outbreaks.

KEY FEATURES OF DISEASE CYCLE: The stem canker fungus survives the winter in seed, but survival in infested crop residue is critical to the development of stem canker epidemics. Spores are produced and infections occur during the early vegetative stages of crop development. The disease then goes dormant until the reproductive stages, at which time symptoms are produced. The severity of stem canker is highly dependent on the weather conditions during early crop development. Wet weather favors disease development.

MANAGEMENT: Plant high-quality, disease-free seed (e.g., certified seed). Rotate crops, especially where full-season soybeans are grown using no-till or minimum tillage methods. Delay planting operations for full-season soybeans. Plant resistant cultivars. Disease is reduced where crops are conventionally tilled. Treating seed with fungicides containing carboxin, thiram, and/or captan may help reduce seed transmission, but will not help to avoid stem canker epidemics. Treatment of soybean with foliar fungicides during the vegetative stages of development can control stem canker, but the results are not always predictable.

SOURCES OF ADDITIONAL INFORMATION:

1. Stem Canker of Soybean, PPFS-52

Sudden Death Syndrome (SDS)

CAUSE: *Fusarium solani* strain A (FS-A)

SYMPTOMS: Initial foliar symptoms are evident as random yellow blotches between the veins of leaves. Spotting may be preceded by a virus-like, mosaic pattern that degenerates into spots. Yellow spots run together and tissue between the veins dies, but the veins remain green. Diseased leaves may be distinctly curled due to excessive drying of diseased tissue. Infected leaflets drop from plants, but the leaf petioles usually remain attached to plants. Flowers and young, developing pods may abort, but mid- to full-size pods only rarely abort. Stems of diseased plants show a milky-brown discoloration. Roots of plants are completely rotted in the later disease stages. Root rot precedes the development of foliar symptoms.

KEY FEATURES OF DISEASE CYCLE: SDS is a root rot disease and the causal fungus is confined to soil and crop residue in soil. Root infection occurs in the early vegetative stages when soil moisture is high. The fungus in rotting roots is thought to produce a plant toxin that causes aboveground symptoms. Aboveground symptoms can occur in the late vegetative stages, but usually appear at mid-pod fill or later. Yield loss due to SDS is most significant when symptoms occur prior to the mid-pod fill stages. Late symptom development can look bad, but yields may be reduced very little. SDS is favored by plant stress. Infection by the soybean cyst nematode is the most common stressing factor in Kentucky.

MANAGEMENT: Delay planting full-season soybeans until late May/early June, or stagger planting dates of full-season soybeans. Spread risk by planting moderately resistant varieties that represent at least two, and preferably three, different maturity groups. No highly resistant varieties are available. Avoid crop stress or injury and manage the soybean cyst nematode, if present. Avoid production practices that encourage soil compaction. Improve internal and surface drainage of fields where problems exist. Full-season soybeans planted no-till may be more susceptible to SDS problems. Crop rotation will have little value in the control of SDS.

SOURCES OF ADDITIONAL INFORMATION:

1. Soybean Sudden Death Syndrome in Kentucky, PPA-37

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